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Teachers for the Knowledge Society

How Can Technology Improve Math Learning Process

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Abstract

Our paper, which is a part of a larger research project, presents the effects that the teaching-learning process based on electronic models has on Romanian primary school students as compared to the traditional one. The basis of our research is an investigation sample made up of 158 pupils. Our comments upon this issue respond to the following questions: how can technology improve maths' learning process? on what grounds? What are the modern models that should be implemented in Romanian primary schools? what are the specific effects these models have on students, how are they perceived by the representatives of the British School, of the French School?

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Keywords: electronic models; teaching-learning process; spreadsheet; eLearning process; operational-cognitive values

1. Introduction

Nowadays playing means learning, communication is the core of the present society (MSM, SMS, etc.), the school is perceived as the place where one meets his/her friends rather than a place for studying, what really counts is the iconic ability (children can open a programme or a game without knowing how to read), learning is nonlinear, which means that knowledge is built through a discontinuous flow of written and audio-visual information. The representative of the new generation is Homo Zappiens, as Wim Veen and Ben Vrakking call him, a model to follow and to put into practice in the teaching-learning process by using electronic models in daily teaching activities (Veen &Vrakking, 2006: 6). The opportunities offered by such electronic models must be exploited in schools, as it is being done in many countries.

2. International context

Electronic models learning (especially by using spreadsheets) has also been implemented in primary school. In their article entitled *Spreadsheets, pedagogic strategies and the evolution of meaning for variable*, Kirsty Wilson, Janet Ainley from the Institute of Education at University of Warwick and Liz Bills from the School of Education and Lifelong Learning, University of East Anglia, as representatives of the English School, consider that the spreadsheets help especially in understanding abstract concepts in mathematics (Wilson, 2005: 322). Spreadsheets are powerful instruments to be used in teaching maths in primary school, gymnasium and high school. They offer "real models to explore the abstract concepts in maths and other subjects (…). A spreadsheet is a helpful instrument

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for the *visual learners* (…). The spreadsheet instruments lead the way towards *problem solving*, asserts Pamela Lewis who is a Computer Coordinator at St. Luke School in Brookfield (Lewis, 2006). In *Intégration d'outils informatiques dans l'enseignement des mathématiques: étude du cas des tableurs,* Mariam Haspekian, a representative of the *French School,* points out numerous advantages of the spreadsheets as a tool when passing from arithmetic to algebra, among which "the interest in creating problems, especially through the trying/ error method, fosters the comprehension of *formula* and *variable* precepts, going from the particular to the general, it helps the reflection, the organization and the control of the work." In *The Utilization of Software Instruments in Teaching Maths* (*Utilisation des outils logiciels dans l'enseignement des mathématiques)*, Jean Pierre Bouvier, also from France, together with de Philippe Sérès, Yves Olivier (specialists in algorithms and spreadsheets) and Bernard Aguer present the advantages of the spreadsheets utilized in high school teaching (Bouvier et alii, 2008: 79-82). Within an annual conference in San Antonio Oscar Chavez, from the University in Missouri, made out a case for his option to utilize the spreadsheet: its dynamic nature, the possibility to see the result of the operation immediately, the possibility to do several operations simultaneously, they can be a natural remedy for the introduction of the variable precept, they can be applied to any operation system (Chavez, 2003).

The spreadsheet is to Sergei Abramovich "an instrument for the complete development of the mathematical concept problem solving", presenting interesting ways to utilize the spreadsheet – with higher levels of education (gymnasium, high school) – in two-variable polynomial solving and as the Fibonacci numbers generator (Abramovich and Leonov, 2009: 3-40). The article On Mathematical Problem Posing by Elementary Pre-teachers: The Case of Spreadsheet by Sergei Abramovich and Eun Kyeong Cho presents the importance of the electronic instruments as tools in mathematical problem posing. The authors claim that the power of this electronic instrument is so great that "at the elementary level, by using a spreadsheet, one can turn a routine arithmetical problem into a challenging mathematical investigation." Numbers used to pose a problem as the previous data may become parameters (variables) that one can use to pose a new similar exercise. In other words, the availability of technology-enabled variation of the syntactic structure provides a source of new problems. The article also presents the advantages of solving Diophantine equation in two or three variables (which they study at the secondary level) (Abramovich and Cho, 2008: 1-19).

The Australian Steve Sugden[2] from the Bond University notices in his article Spreadsheets: An Overlooked Technology For Mathematics Education the necessity to include spreadsheets in the teaching-learning process: "Electronic spreadsheets have been with us for more than 25 years, yet in Australia, they are not common in mathematics classes." Although this electronic model – the spreadsheet – is present on essentially every desktop or computer, it is often routinely ignored for mathematical modelling and instruction. His reference aims at using the MS Excel which presents numerous advantages, among which its ubiquity, and it was also used within other lessons: "When superior tools such as Excel are widely available, it is difficult to understand the graphics calculators choice." Thus, the Mathematics and Computation professor says that he questioned mathematics educators and offered them some suggestions for its incorporation into the mathematics classroom, motivating that more than half of the students (almost 60 %) do not know certain mathematical concepts easier to understand with the spreadsheets as a learning tool (Sugden, 2007: 68-74). The same author presents the possibility to create different games with MS Excel, for instance Sudoku puzzle based on the set theory in the article The spreadsheet as a tool for teaching set theory: Part 1 – an Excel lesson plan to help solve Sudokus (Sugden, 2005: 68-70).

A perspective of the spreadsheet as a tool in the educational context in Turkey is offered by M. Miraç Özar in the article Spreadsheet in education, where he mentions a few motivational aspects: "The teacher is not only responsible for teaching his or her subject but also for making the subject enjoyable and motivating." The cognitive and the psychomotor aspects are also very important to mention. The final conclusion was that more supporting materials about different ways of teaching lessons with Excel should be available. "Spreadsheets build an ideal bridge between arithmetic and algebra (…). Therefore, spreadsheets have become an important part of many different curricula at different levels of education." (Őzgün-Koca, 2000: 3-4). The researcher Keith Jones from the Southampton University has an important point of view to spreadsheet as a tool. Out of the short presentation entitled Using Spreadsheets in the Teaching and Learning of Mathematics: A Research Bibliography, we find out that "although not designed as an educational tool, (spreadsheets) have been used in mathematics classrooms since

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they first became available" in the teaching-learning process in England. The researchers' opinions regarding the spreadsheet electronic model converge towards the same idea supported also by the Great Britain representative, K. Jones: "One way that seems to help pupils move from a non-algebraic to an algebraic approach is through work with spreadsheets." (Jones, 2005: 30). A paper which combines the theoretical with the applied side based on spreadsheet work is IT in Primary Science written by Roger Frost. We find in it several reasons to convince us use this electronic model: "spreadsheets have an astonishing range of functions that can help with maths", "spreadsheets can work out the total or average of a column, look for maximum or minimum values and turn any mathematical trick." The IT tools for processing information in the educational process include database programs and flow charts, spreadsheets programs, water, temperature, pressure, position sensors (less known to us, they are presented in the pictures as peripheral elements of computers). An example of using light sensors within the natural science lesson starts from the question Which colour should a cyclist wear? and the pupils are to identify the light level with the help of the sensor connected to the computer (Frost, 2004:27-35). Another complex work about the organization and application of spreadsheets in the educational process is Spreadsheet Magic by Pamela Lewis which includes no less than 40 lessons at the elementary school level for the following domains: social studies, science, music, mathematics. From the kindergarten level up to the sixth grade one, the lessons include a theoretical part as well as computer activities (Lewis, 2006). The representatives of the Italian School, M. G. Bartolini Bussi, G. Chiappini, D. Paola, M. Reggiani and O. Robutti, present the newest research regarding the IT&C technology used in school in their article entitled Learning Mathematics with Tools. At national level, the proper electronic tools such as spreadsheets, Power-Point presentations teaching-learning database programs are little studied and rarely applied as didactic instruments.

3. The Proper Experiment

Our research project starts from the hypothesis that including cognitive schemes, conceptual maps, diagrams, cartoon elements, communication means, spreadsheets will increase the level of sensibility and the receiving of new information, as well as the stimulation, imagination, enthusiasm clues, will lead to a different level of the student-teacher interaction, will personalize the working method at class level, they will increase the level of involvement in the collective activities of beginner and advanced pupils, they will make the educational process more efficient at the global level. The research database has involved a 158 –pupil sample (109 girls and 81 boys) divided into two second grades, two third grades and two fourth grades. During the research, we have identified the parasite variables that had been kept constant in order not to influence the final result. The experimental and control groups have been pre-tested in order to be "equivalent". The lessons have been electronically drawn up taking into account the references of the respective class educators (the pupils' level, the answer time, the way of thinking, the work space etc.). Following the application of the U-Mann Whiteny test the general tendency was that the pupils in the second, the third and the fourth grade experimental groups got significantly better results than those of the control groups' pupils.

The results generated by SPSS for the third grade in the electronic models pre-testing with an average of 9.38 are represented in Figure 1, while in the post-testing there is an average that went up to 9.63 (see Fig. 2).

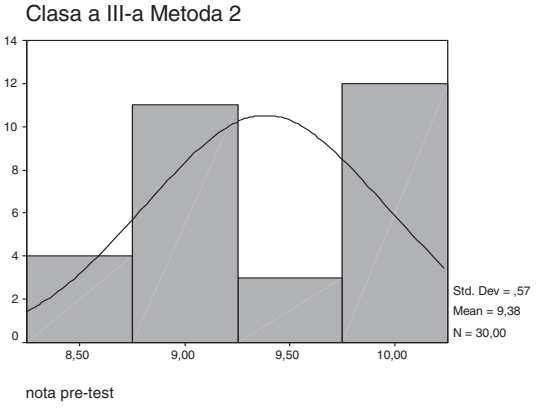

Fig. 1 Pre-testing representations

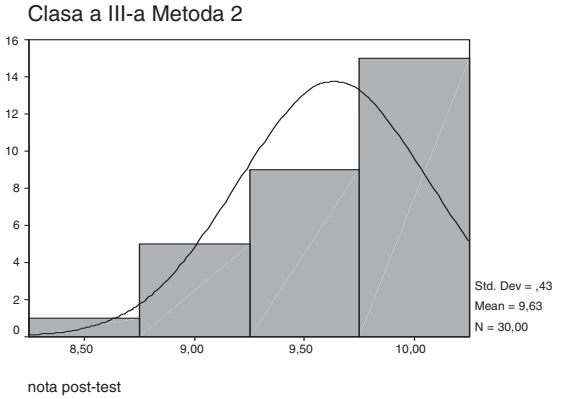

Fig. 2 Post-testing representations

The beginner pre-tested pupils (second grade) got an average of 9.46, while in the post-testing the same pupils got an average of 9.77, which indicates a positive influence of the eLearning models (getting better results). For the advanced pupils, the fourth grade pupils (the final grade for elementary school), the difference between the pre-testing and the post-testing is significantly improved as compared to the other elementary classes. In the pre-testing the average obtained was 8.7 and in the post-testing it was 9.27. There are a few explanations for the increased value of the marks obtained in the post-testing by the fourth grade pupils as compared to the beginners: the previous experience in the computer work; the higher level of interest in the new type of lessons; the reward almost nonexistent in the traditional class attracts them more; the multitude of games and games is much desirable in the learning process (as contrasted to the mathematics workbooks which gradually have – starting from the first grade to the fourth grade- less and less pictures); the mathematical abstract precepts are more and more rarely explained through pictures (in supporting auxiliaries, it does not exist).

Out of all the obtained results at the elementary school level we conclude the following: the pupils' performance improves when the teaching-learning electronic models are utilized; influences are more evident for the advanced pupils (see figures in the pre-testing and the post-testing for the fourth grade); for the third and fourth grades the electronic models were Microsoft PowerPoint-based; for the second grade the electronic models was spreadsheet-based (Microsoft Excel).

4. Conclusions

Beyond the issues of the computers-endowment we can say that the values of the electronic instruments intended to be implemented in the educational process in the Romanian schools as well as in the Balkans, are necessary in the not-too-distant future. Hence, the need to update, to improve and to increase the percentage of motivation and efficiency of the new information. We should also keep in mind the fact that the time used by the younger generation as compared to the volume of knowledge is nowadays much reduced , that is why we should positively use these new 'extra-options' to ensure the success of the generation which studies 'differently' and which should be instructed in this way, too.

The reasons for which we support the implementation and the efficient practice of these eLearning models with operational-cognitive values, especially, could be the following: the low cost, their applicability in various domains, the easier drawing up of personalized, efficient lessons, the provability of the transferring effects of their utilization, the faster, more profound and easier way to understand certain mathematical concepts.

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